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**No. 290**

# Organizational Capability in use of IT and Supply Chain Management

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February 2010

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Manufacturing Management Research Center (MMRC)

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Abstract (100 words)

Many firms in today's business environment utilize diverse information systems to sustain their competitive advantages. However, too often the return of investment on information technologies is not as obvious as expected. This is particularly true with many small and medium enterprises. This paper presents a research model and examines how mobile display manufacturers implement their information systems for the enhancement of supply chain performance. For the purpose of this research we involve two firms and consider critical success factors of their information integration practices. One successful firm which has organizational capability in IT use links its existing database to new information systems and aligns its information system for the larger requirements of supply chains. Another firm possesses different organizational capabilities and accordingly shows the poor outcomes. Based on extensive interviews with the IT executives, supply chain professionals and IT vendors within the supply chain network of these two firms, we present our findings. Lessons and implications are discussed.

Keywords (five words)

Organizational Capability, Database Integration Capability, Supply Chain Management, Information System, Mobile display manufacturers

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## 1. Introduction

Modern manufacturing firms operate in very challenging circumstances. Sustainable competitive advantages require more than applying efficient mass production methods or securing adequate market share. The global competitive landscape continues to dictate firms to devise faster responses to the changing market demands. In this context, increasingly firms adopt product lifecycle management (PLM) and supply chain management (SCM). With the application of PLM firms try to meet comprehensive customer requirements with complex product features by flexible innovative capabilities (Garwood, 2006). By PLM firms aim to achieve business successes from the standpoint of the entire product life cycle (i.e., birth, growth, maturity and termination). On the other hand, by SCM firms deal with continuous value flows (i.e., information, product and cash) from the perspective of supply chain value network. In this sense, supply chain management (SCM) shares a real similarity with PLM in terms of goals, processes and outcomes. For both PLM and SCM it is critical to maintain an integrative database with those of component parts suppliers, production facilities, distribution, and customers.

An example of complex manufacturing database is bill of materials (BOM). BOM is essential for manufacturing management. BOM is information chain pathways for assembling components of certain product, which define the fine details of fulfilling customer orders and design specifications that involve the functions of sourcing, manufacturing and maintenances. Deploying right products that meet changing customer needs is a key for the firm's competitiveness. Thus, it is critical for firms to manage demand chain through the use of well-designed product database that facilitate effective information flows about customer changing needs (de Treville, 2004; Walters, 2008). A successful fulfillment of complex customer requirements at the right time requires the design and use of integrative database. The real challenge is how to integrate manufacturing-related BOM with management-oriented database.

In fact, many firms fail to meet the changing customer requirements because of the inadequate integration between manufacturing database and other functional database. Product demand management (PDM) may involve a huge investment and yet its effect is too often disappointing. One global firm successfully implemented PDM by integrating the diverse IT systems including marketing information (product development information), concept information (functional information), design information (technology information) and production information (supplier production network information). Such complex information system integration allows the firm to achieve faster product development and sustains global competitiveness (Park et al., 2007). In response to global SCM requirements, firms build global ERP (Enterprise Resource Planning) along with diverse SCM systems. As a way of meeting changing customer requirements firms choose APS (Advanced Planning and Scheduling System) which is more advanced than the past MRP system. Such innovative IT system will work only if an effective integration with other functional system database occurs. In fact, massive IT investment does not necessarily generate tangible business results. In view of these findings the key assumptions of this paper are: (1) effective IT system integration is critical for desirable business outcomes; (2) IT integration effectiveness indicates the firm's organizational capabilities. For the examination of the above assumptions this study presents a comparative analysis of mobile display manufacturers in respect to their IT organizational utilization capabilities.

## 2. Literature Review

### 2.1 SCM and Database integration Capability

Integrating the efforts of diverse players across the supply chain is an important research focus of supply chain management (Zhang, 2006). Suppliers and customers work as partners for the common objective of enhancing competitiveness and profitability for the whole supply chain network (Patterson et al., 2003). Since value creation in supply chain depends on effective information flows, key success factors for a supply chain require strategically aligned inter-organizational IS that achieves accurate demand forecasting and cost effective inventory management, transactional activities and procurement processes (Whipple and Frankel, 2000; Gunasekaran and Ngai, 2004). Successful participation in e-marketplaces assumes firms to integrate their internal and external supply chain activities through strategic and operational information sharing. Therefore, construction of appropriate IT system is indispensable in design and implementation of a SCM strategy (Park et al., 2007). In particular, integrating database is a prerequisite to the successful adoption of new IT system. Without integration of all existing database, a huge investment of the new IT system would be in vain. For example, mere adoption of 3D CAD system without corresponding organizational innovation may not achieve the desirable outcomes (Robertson and Allen, 1993; Tan and Vonderembse, 2006). The widening gap between the intended goals of the 3D CAD system investment and actual outcomes of its use is quite real in many organizations (Beatty, 1992; Park et al., 2007). The underutilization or ineffective use of CAD is suggested as the primary reasons for such undesirable performance gap (Buxey, 1990; Liker et al., 1995; Park et al., 2007; Robertson and Allen, 1993; Twigg et al., 1992).

3D CAD-CAE also promises reduction in development time through front loading and smaller design changes with appropriate organizational capabilities (Fujimoto and Nobeoka, 2006; Fujimoto, 2004; Thomke and Fujimoto, 2000). Yet, differences of organizational capabilities account for the huge outcome variations of IT system utilization. With the implementation of the same types of IT systems the average product development time of Japanese auto-manufacturers is no more than 18 months while USA firms report the time for average new product development projects for more than 30 months (Fujimoto, 2006). In another study, the US (Chrysler as an example) and European firms adopted 3D CAD three years earlier than Japan and the actual results show that Japanese firms are ahead in virtual digital mockup (Fujimoto and Nobeoka, 2006). In the late 1990s, most of USA Firms adopted 3D CAD for the full design draft (100%) of component parts while Japanese counterparts did only 49% of that of component parts. Japanese firms were lagging behind USA Firms in terms of IT technology adoption, yet their better operational performance suggests that it is critical for functional specialists to master organizational routines for innovative problem solutions (Park et al., 2007). These findings indicate that the organizational capabilities matter in determining the outcomes of IT system implementation (e.g., CAD, ERP).

In the firm level we now consider BOM database which covers all the business processes (i.e., design, manufacturing, purchasing and after services). The foundational database for product BOM consists of master BOM, design BOM (E-BOM), manufacturing BOM (M-BOM), purchasing BOM and service BOM. Master BOM controls other functional BOM (i.e., E-BOM, M-BOM, purchasing BOM, service BOM). However, these BOM and other related data may be stored in the form of local files. Therefore, they may not be standardized. In this case, even the most outstanding new IT system might not produce any desirable system outcomes. On the other hand, any firm that has built integrative database may secure a better competitive position. For example, in Bentley, the scientific experiment tool maker, almost all production design was done by the cutting-edge technology veteran during 1960-1970. However, in the process of introducing new products the firm processes more than 1,000 types of engineering change orders (ECOs) each year. Once it experienced the loss of all the data with a fire accident. Afterward, Bentley adopted ERP system. For the implementation of an integrative system all the key stakeholders within the firm gathered in a meeting room. Their implementation planning covers all business processes with the use of a unified BOM database. As the result, it achieved the rapid rate of business growth with the support of integrative and unified database that are linked to marketing, sales, cataloguing, technological documents, design pattern files, product database (Garwood, 2006). A case like this suggests the strategic importance of integrative database. This paper explores the value of having integrative database among diverse IT systems. Case studies illustrate that IT integrative effectiveness depends on organizational capabilities as well.

### 2.2 Research Model

For the purpose of this paper we adopt the perspective of supply chain management. Figure 1 shows database integration capability. It descries inter-relationships that involve existing systems (ERP, MES and other systems), Meta Database, and Advanced Planning and Scheduling (APS). A new IT system (e.g., APS) utilizes the existing ERP, MES and other database systems and therefore enhances the total integrative data capabilities which in turn expand the firm's organizational capabilities. In this paper, we assume that the level of integration with the existing database (e.g., ERP, MES) may impact the outcomes of the newly adopted IT system.

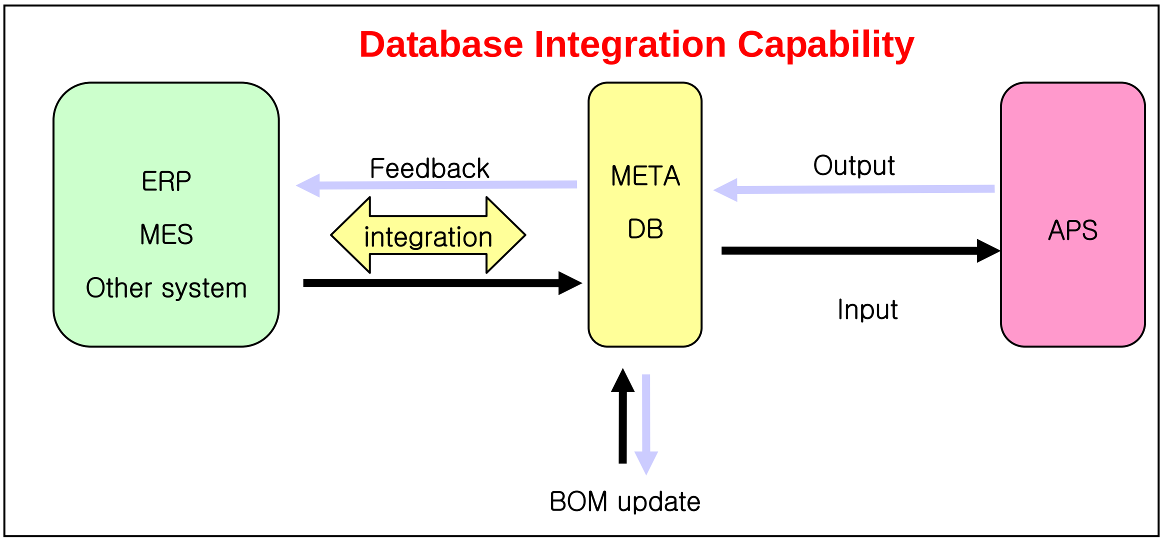



Figure 1. Research Model

## 3. Case Studies

This paper examines the cases of the adoption of Advanced Planning and Scheduling (APS) system by Mobile Display Manufacturers. We compare the experiences of two organizations (Firm A and B) in terms of database integration capabilities.

### 3.1 Case A

Firm A had the following management goals in the environment of fluctuating market demand, intense display production and price competition: (1) immediate response to customer orders, (2) strength of automation of production planning (3) optimization of production schedules (4) efficient utilization of resources, (5) reduction in lead-time (6) cycle time reduction (7) improvement of delivery reliability (8) inventory reduction. For the accomplishment of the above goals it was important to link MES system and production scheduling. By adopting these systems the management anticipated the systemization of production planning, productive utilization of limited resources, flexible responses to changes, and cost minimization.

Table 1 shows two kinds of factories: domestic and overseas. It also shows the different types of shops (array, cell and module), # of production lines, production processes work units, and comments. Specifically, the firm planned to adopt APS system in its Array Process 3 Line (AP3L), Cell Process 3 Line(CP3L), Module Process 6 Line(MP6L) of domestic plants.

Table 1. Adoption Plant

| Factory | Shop | # of Product Lines | # of Production Processes (MES based) | # of work groups (ERP based) | Comments |
|---|---|---|---|---|---|
| Domestic Factory | -Array<br>-Cell<br>-Module | -3line<br>-3line<br>-6line | -Around 100 | -25<br>-10<br>-10 | Sacrifice of process that becomes basis of production |
| Overseas Factory | -Module<br>-Array, Cell -> building plan | | | | |

In this section we first introduce Mobile Display Production Process which is a critical component of successful IT adoption of Firm A. The basic production processes include Array

Process, Cell Process, and Module Process. Array Process includes transistor board and CF board. In Cell process, panels are made by the combination of transistor board and CF board. In module process, other supportive component parts are added. The below Figure 2,3 and 4 show the details of all these processes.

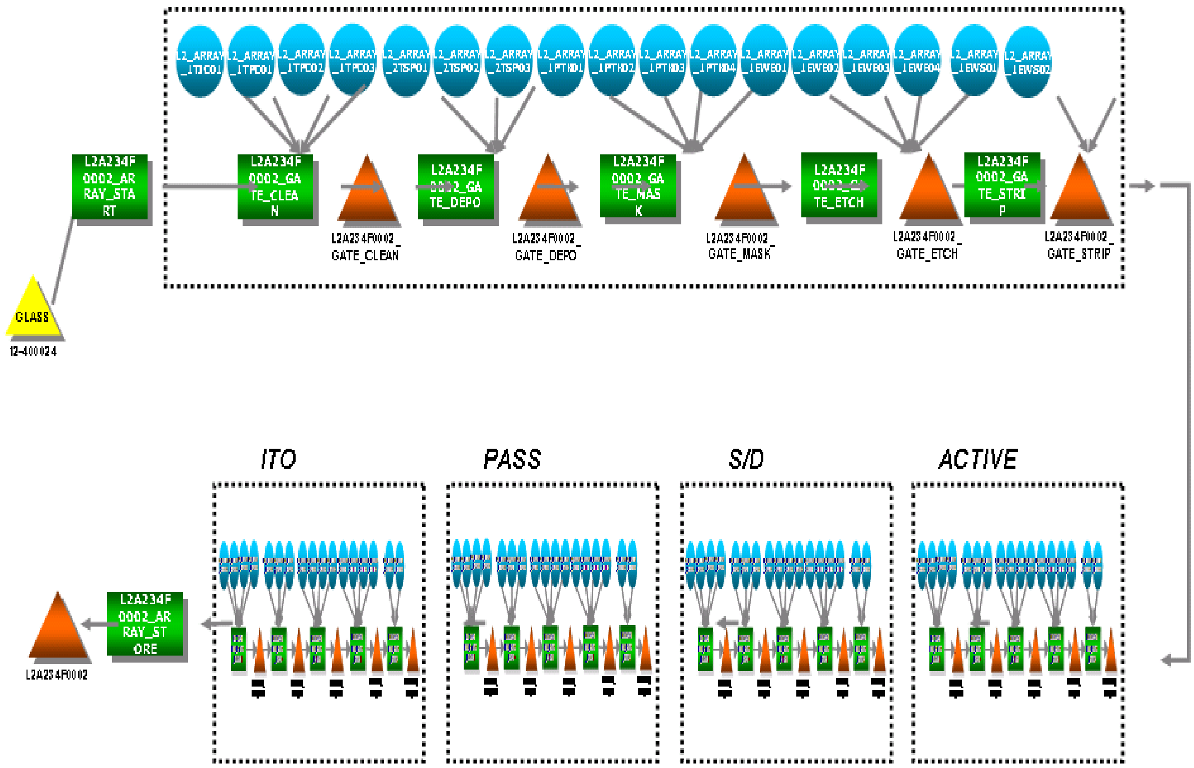



Figure 2. Array Process

Figure 2 is the array process. It is the process of depositing transistor on glass substrate. It includes deposition process, photolithography process and etching process. Through these serial processes transistors are arrayed in the right sequence on glass substrate. It is unique and different from semi-conductor processes in that instead of wafer glass is being used.

Figure 3 shows the cell process. Transistor is placed in the bottom layer and color filter is on the upper layer. As these two are attached in order, spacer is used and then these particular LCD processes are completed with seal printing that requires liquid injection through the fine tunnels in between the two layers.

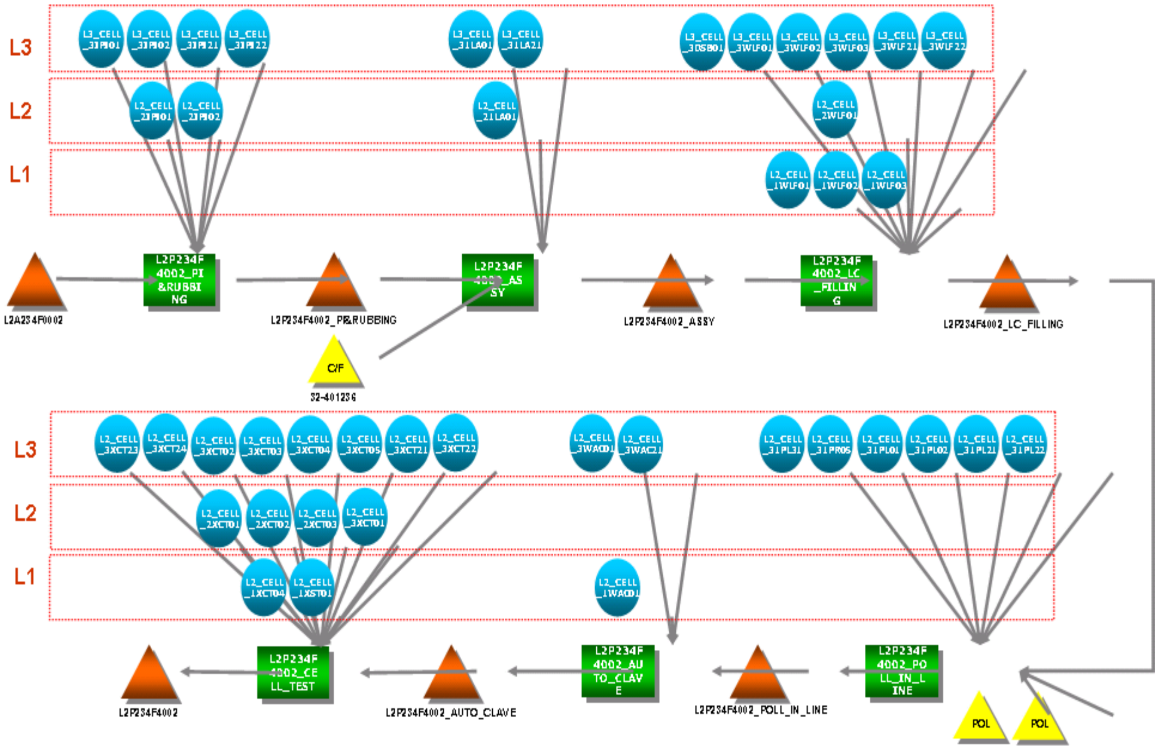



Figure 3. Cell Processes

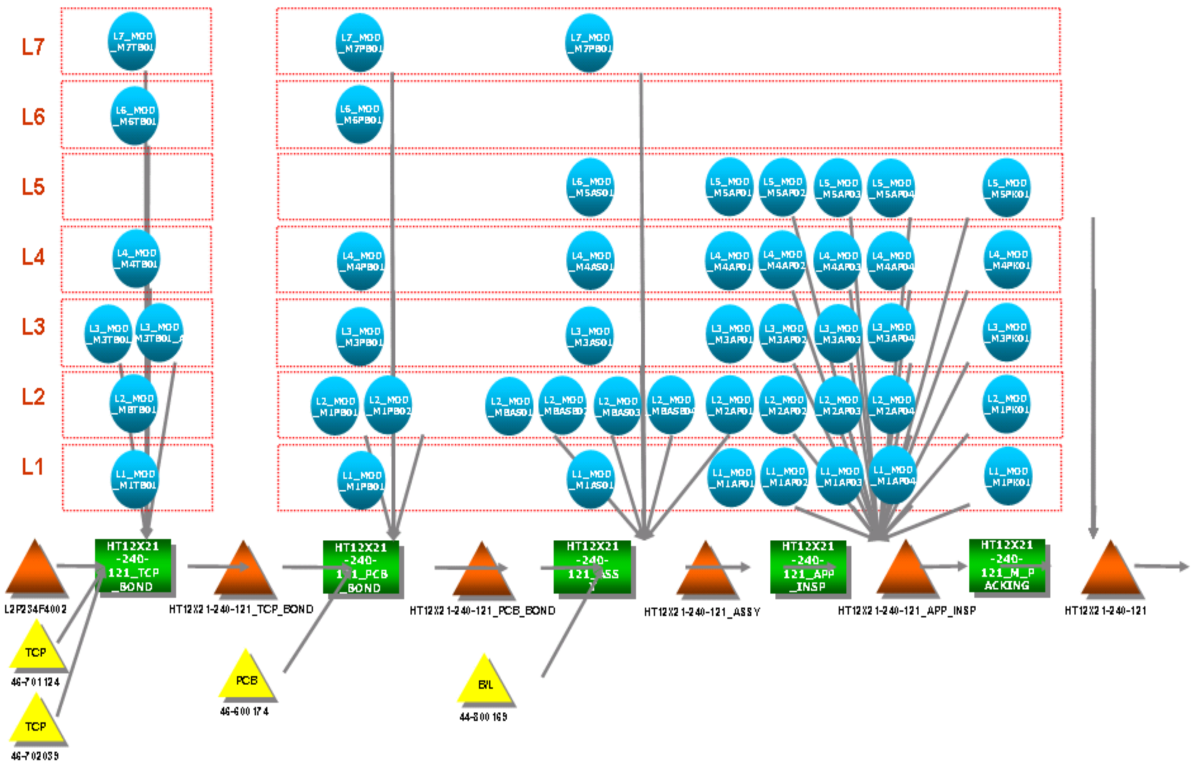



Figure 4. Module Process

Figure 4 is the module process which determines the quality of products that are delivered to the customers. It is the process of attaching polarizer to the panel which passed cell process, then including Driver-IC, assembling Printed Circuit Board (PCB) and completing module process with adding backlight unit.

The time frame of this IT introduction project is six months. The first step is to make production plans on product line/shop level/daily basis. It makes an automated pilot system that generates the production plans for two months within a few minutes. Then, it provides the system proof-of-concept according to daily and process level in-out planning requirements. In this way, realistic plans for LCD production are prepared that reflect diverse facility and parts constraints.

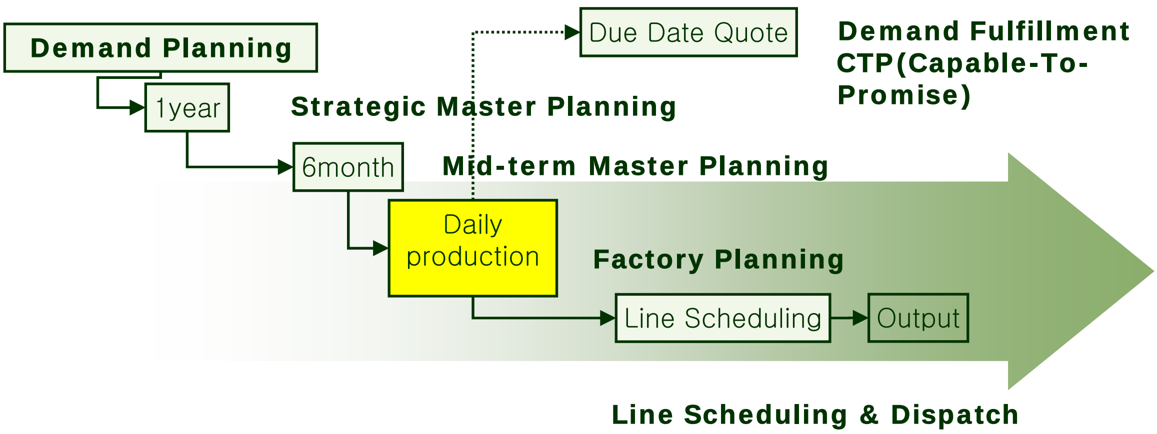



Figure 5. Building project according to SCM processes

However, the newly introduced APS system produced scheduling by using Meta database from existing enterprise system. In the course of the system introduction the master database failed to integrate the core of all system within the planned time frame of six months according to the vendor’s requirement. The existing database (e.g., SAP, MES) was assumed to be reliable. In reality the database was not integrated. The new system failed to generate the credible production schedules with the use of inaccurate old data outputs.

Later, it is discovered that the heart of these problems is the failure of the manufacturing director. With continuous inter-functional conflicts and political pressures the manufacturing director was unable to involve other functional directors to integrate other specialized database (e.g., product design information, purchasing, marketing, accounting and finance information). Thus, this wonderful project did not produce the intended desirable results in spite of vendors' serious launching efforts.

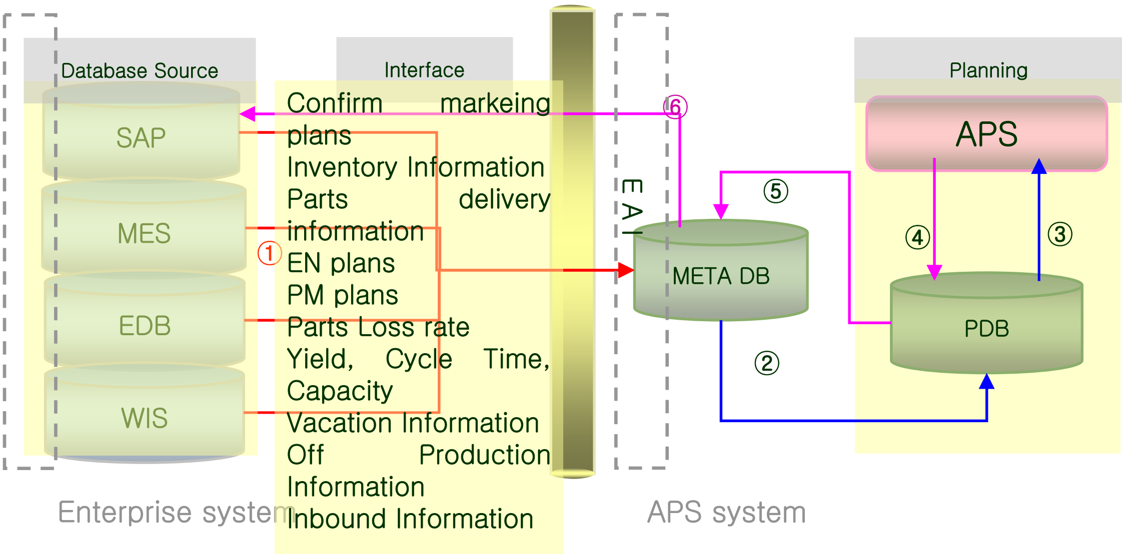



Figure 6. Integration Issues with ERP Database

### 3.2 Case B

Firm B is also mobile display manufacturer. It implemented the assembly of display products in its overseas plant in China. Just like Firm A, Firm B also experienced frequent changes in production plans because of the fluid market environment.

To overcome these problems, Firm B adopted APS system for six months starting from February 2008. However, it successfully completed the project two months earlier than planned. Firm B built flexible production methods by implementing daily deadline check, daily production order, efficient production schedule and reducing the numbers of changes in planning and its ratio. The outcomes of this system introduction showed the drastic improvement in production planning.

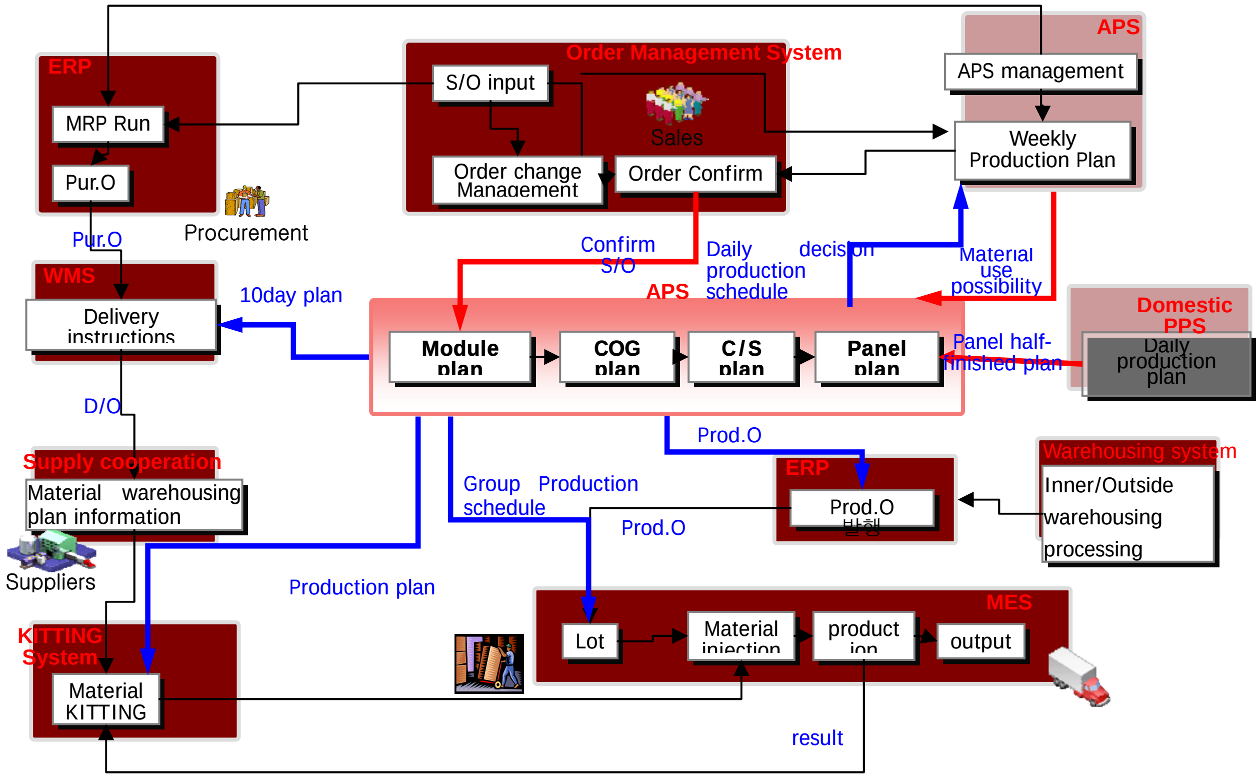
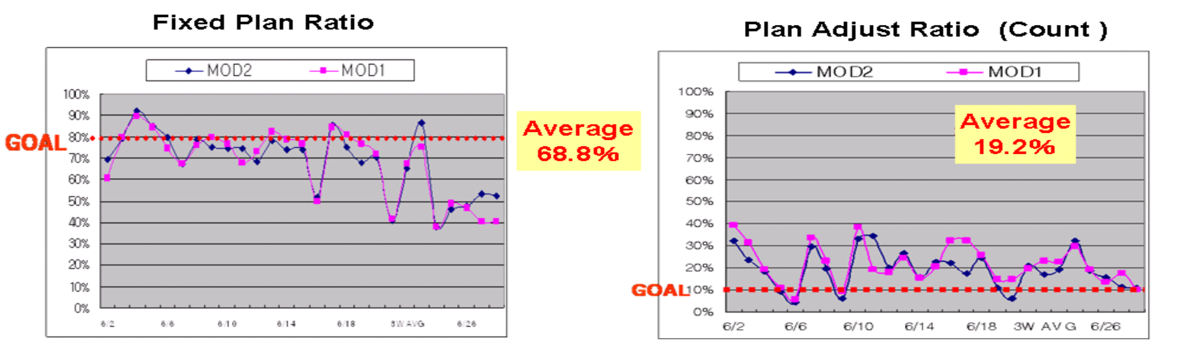



Figure 7. Basic database system and newly adapted APS system

Figure 8 indicates a vast improvement in terms of fixed plan ratio. In regard to 80% target of fixed plan ratio (FPL), the actual performance outcomes are average 68.8% just after the introduction of the above mentioned project. Plan adjust ratio (PAR) now achieves 19.2 %( average) compared to target ratio of 10%. In view of the past planning ratio changes (more than up to 80% of planning adjustment) it certainly is the outstanding success.




$$FixedPlanRatio = \frac{\Sigma_{model,line} MIN(Before D-2 \text{ dayplan}, D \text{ dayplan})}{\Sigma_{model,line} MAX(Before D-2 \text{ dayplan}, D \text{ dayplan})}$$

$$PlanAdjust\ Ratio\ (\text{Count}) = \frac{\Sigma ABS(Plan - Adjust)}{\Sigma(Plan\ \text{Count})}$$

Figure 8. Outcome of IT system introduction

## 4. Discussion

The above comparative analysis of two mobile display firms suggests how the existing database is integrated with the new IT system. Firms can achieve the greater IT utilization outcomes through integrating diverse system database. Then, why is it so challenging for many firms to integrate their database systems? Our case studies show that many firms fail to integrate their database for a few obvious reasons.

First, successful database integration requires the corresponding level of IT investment. The cases discussed in this paper report the integration effects of the old IT systems on new APS system introduction. Our recommendation to Firm A (in view of its failures to produce desirable results) is, “Complete the efforts of integrating the existing database systems”. This requires additional IT investment for the construction of unified database system. Such a high level of investment requires the substantial resources of the firm. For example, the successful data integration of Samsung Electronics, a Korean global firm, is possible with its huge investment capabilities.

Second, organizational capabilities are essential for effective database integration. In addition to an appropriate level of IT investment the management leadership needs to exercise a strong decision-making influence. For example, Korean and Japanese organizational structure and management leadership shows noticeable differences. Compared to Korean firms, many Japanese firms lack in strong management leadership. Besides, the walls between diverse business units are too high to achieve cross-functional integration. Korean firms accomplish database integration of IT system through effective top-down decision-making. On the other hand, Japanese firms that focus on the efficiency of users do not accomplish the integration across organizational units. It is possible to attain IT system and database integration if firms are willing to exercise serious disciplined leadership to achieve the effectiveness of the entire organization. This organizational leadership challenge is what Japanese firms need to accomplish the desirable IT utilization outcomes and global competitive advantages.

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